Global Power Markets – Why Should the U.S. Care

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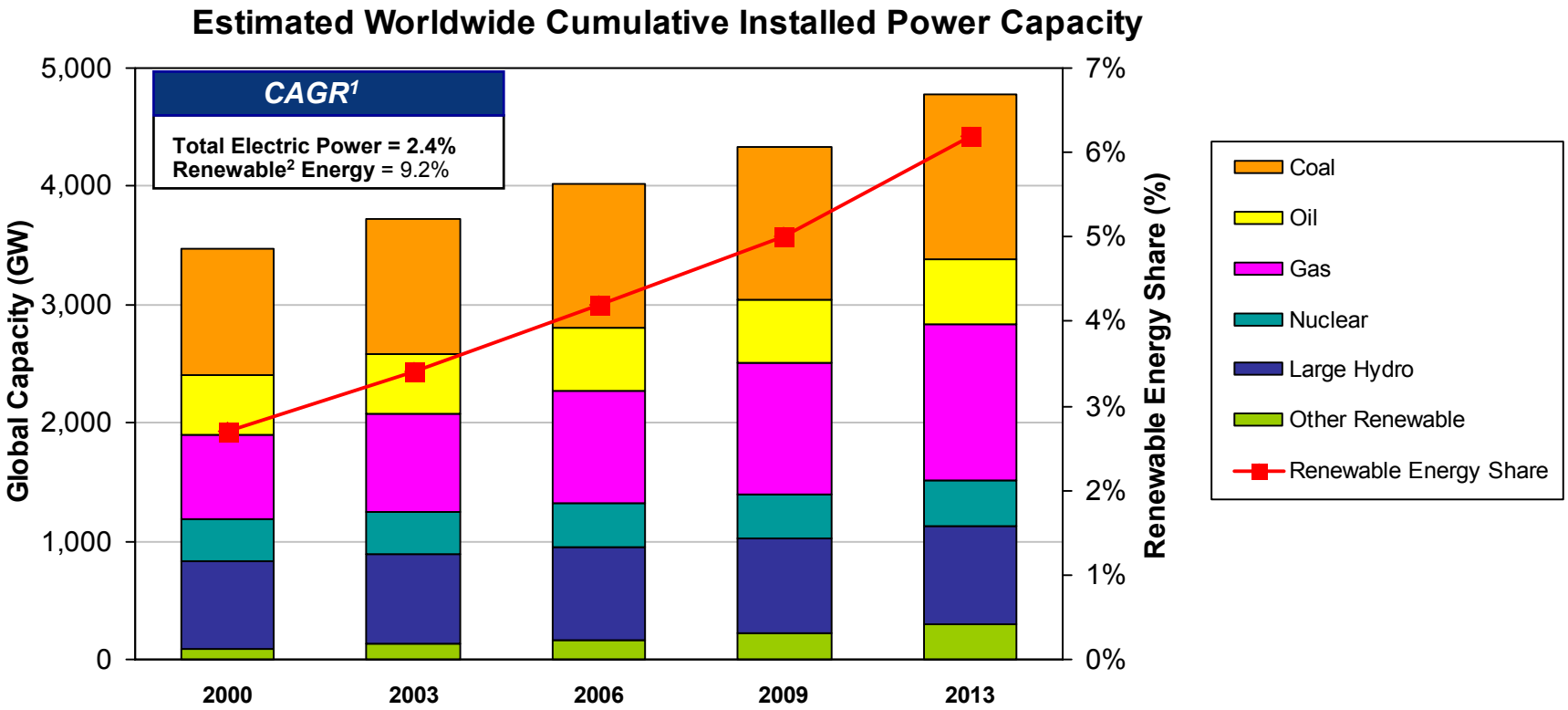
Global worldwide cumulative power capacity is projected to grow from ~ 3,700 GW in 2003 to 4,800 GW in 2013.



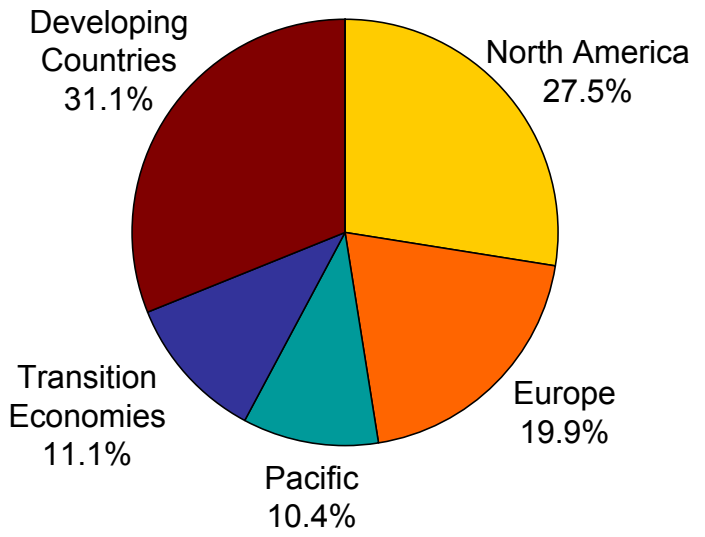
Source: IEA *World Energy Outlook 2002* with NCI estimates of renewable energy, June 2003.

1. CAGR = Compounded Annual Growth Rate
2. Other renewable energy includes biomass, wind, photovoltaics, geothermal, low impact hydro, and concentrating solar power.

Power needs outside of North America represent ~75% of the total world market power demand both today and in 2013.

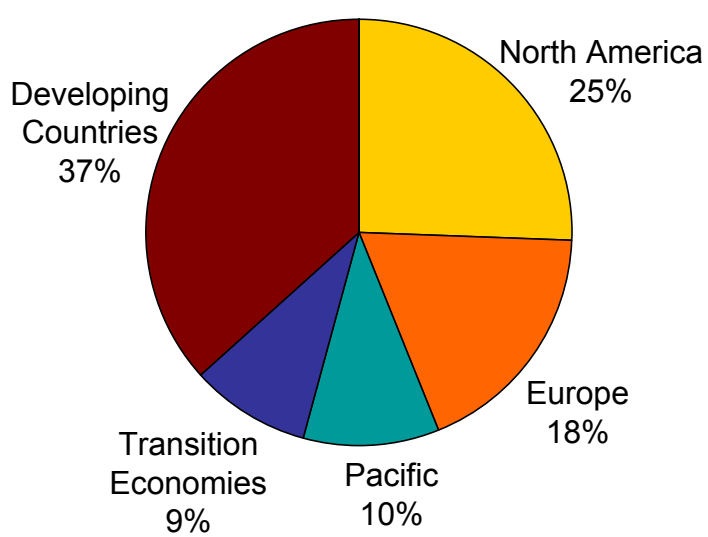
Capacity Distribution by Region (2003)

Total 2003 Capacity = 3,729 GW



Capacity Distribution by Region (2013)

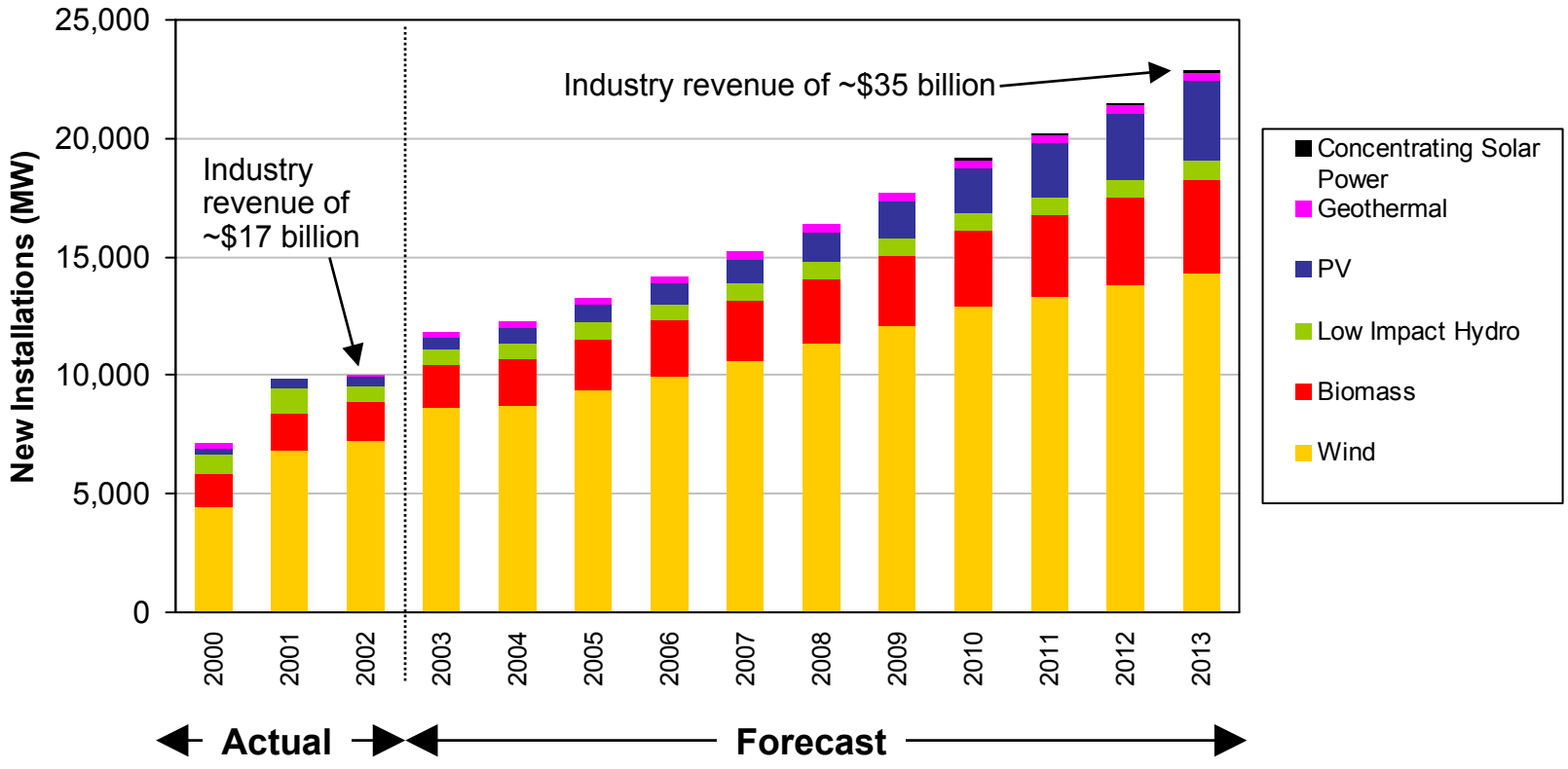
Total 2013 Capacity = 4,782 GW



1. Source: IEA World Energy Outlook 2002 and NCI estimates, June 2003.
2. Transition Economies includes Eastern Europe and countries in the former USSR.
3. Developing Countries includes the regions Asia, Latin America, Africa and the Middle East.
4. Pacific includes Japan, Korea, Australia and New Zealand.

The renewable energy equipment business today is about $17 billion annually*. This is expected to reach about $35 billion by 2013.

Estimated Annual Worldwide Renewable Energy Capacity Additions



Source: NCI estimates based on EIA, International Energy Database, February 2003 and interviews with various renewable energy manufacturers, May 2003.
*Excluding large hydro

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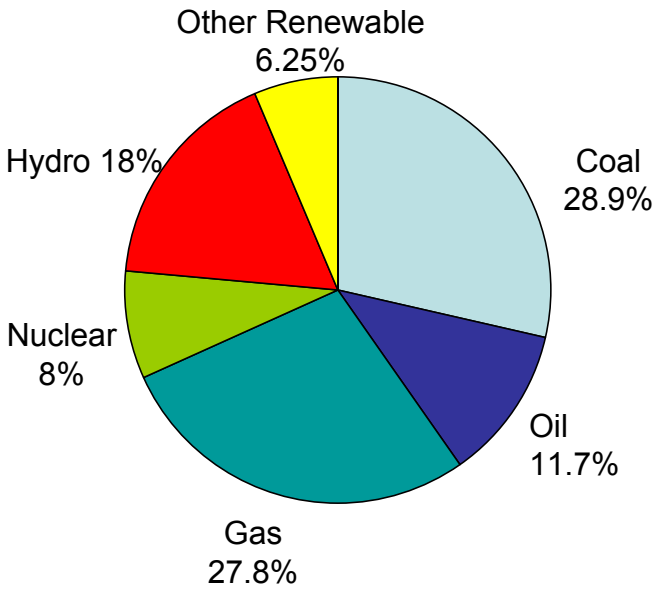
Renewable energy capacity in 2013 is expected to achieve about 300 GW, compared to about 116 GW in 2002, with wind and biomass technologies providing the largest market share.

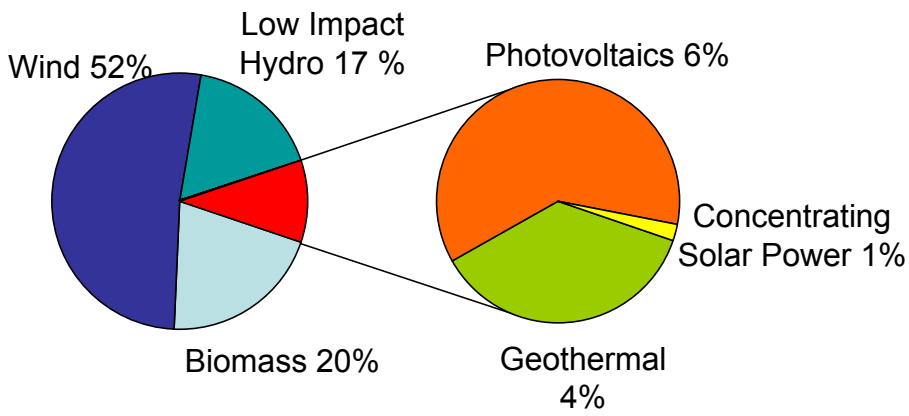
Capacity Share by Fuel (2013)

Total 2013 Capacity = 4,782 GW



Renewable Energy Market Share (2013)

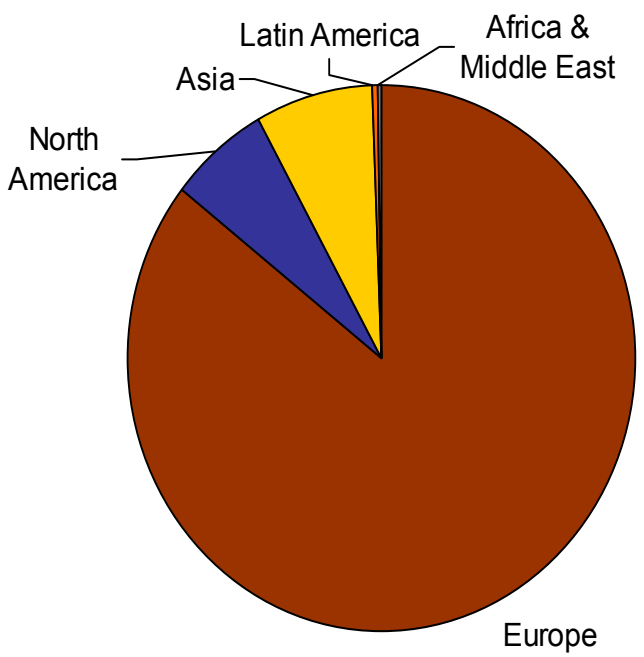
Total 2013 Capacity = 300 GW



1. Source: NCI estimates based on IEA World Energy Outlook 2002 and interviews with renewable energy manufacturers.
2. "Other renewable" includes biomass, wind, geothermal, concentrating solar power, photovoltaics, and small hydro.

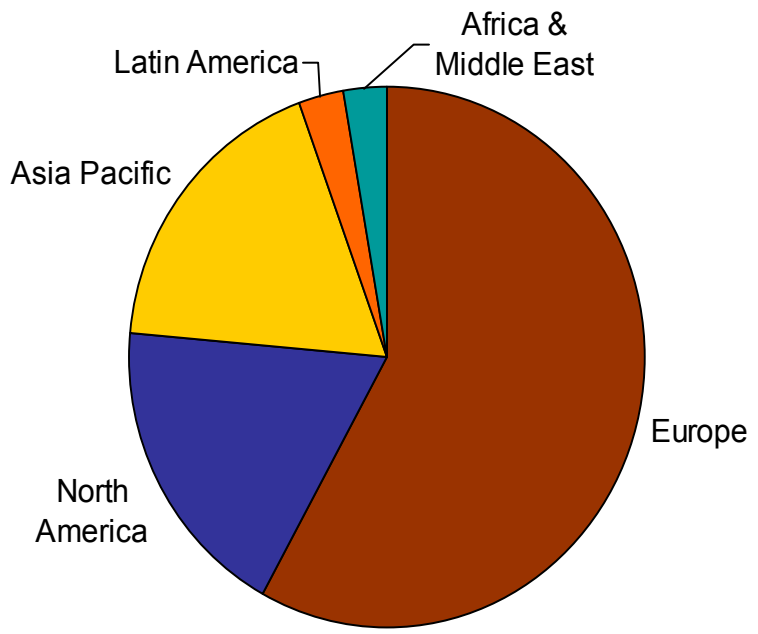
Large opportunities for wind energy development over the next ten years are expected to be in Europe and Asia Pacific.

Wind Capacity Additions (2002)



2002 Capacity Additions = 7,210 MW
2002 Installed Capacity ≅ 32,000 MW

Wind Capacity Additions (2013)

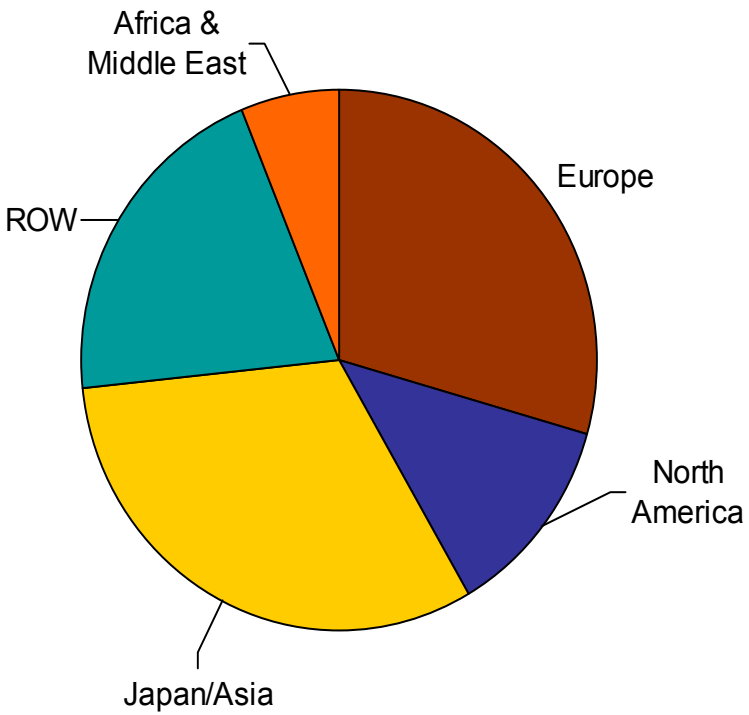


2013 Capacity Additions = 14,300 MW

Source: NCI estimates based on *International Wind Energy Development, World Market Update 2002*; BTM Consult ApS, March 2003; BWE 2003; AWEA, 2003; and interviews with wind developers, 2003. Asia Pacific includes: India, China, Japan, Australia, New Zealand, and other Asia.

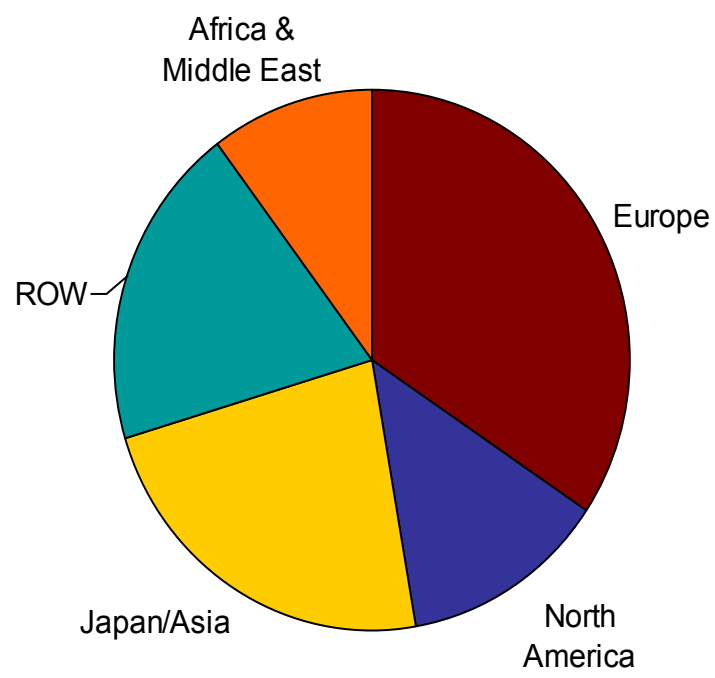
Although there will be significant opportunities for photovoltaics in the U.S. over the next ten years, other parts of the world represent 86% of the expected demand.

PV Capacity Additions (2002)



2002 Capacity Additions = 422 MW

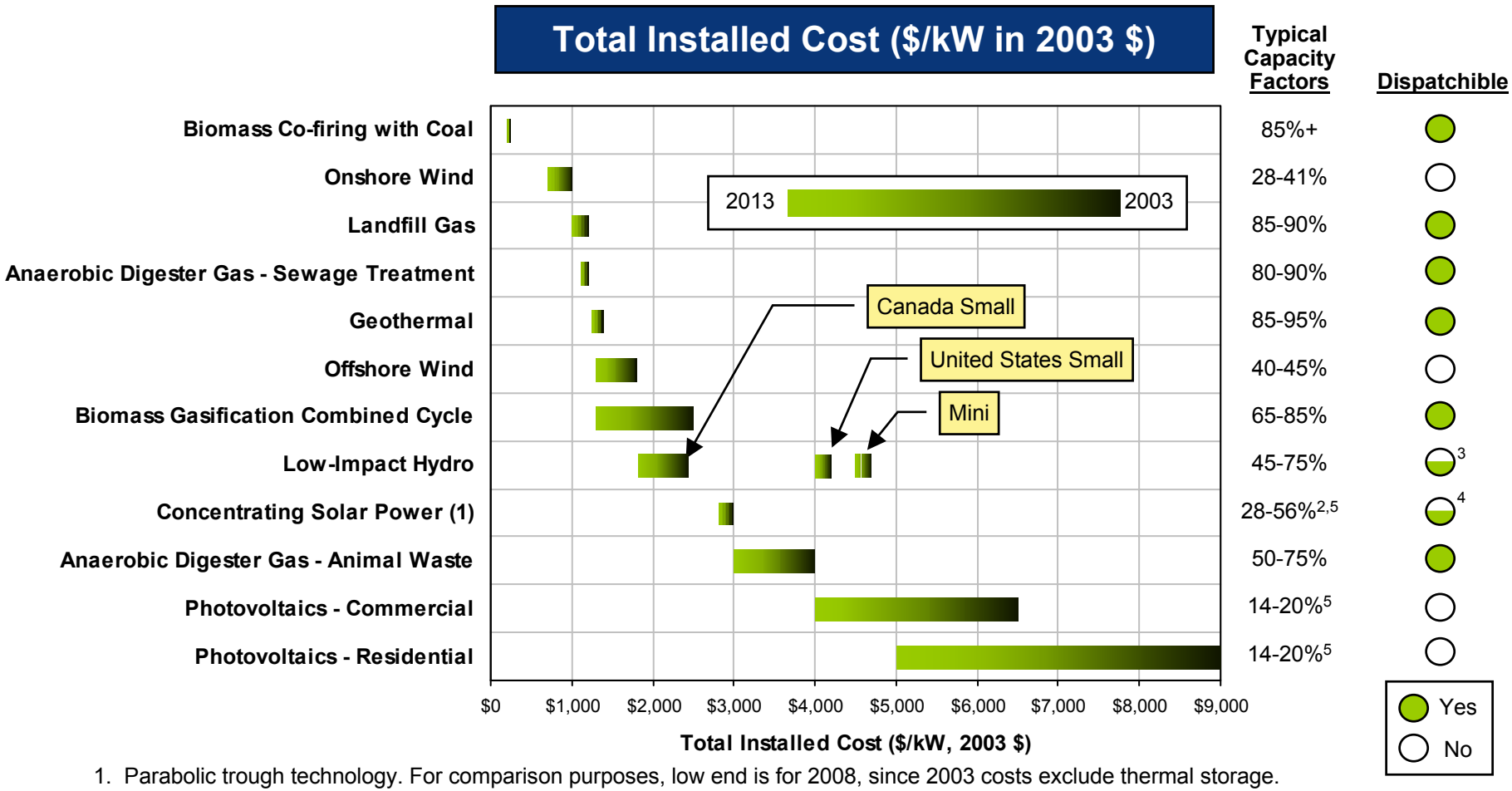
PV Capacity Additions (2013)



2013 Capacity Additions = 3,370 MW

Source: NCI estimates based on interviews with PV manufacturers and system integrators, 2003.

Future growth in renewable energy markets will be driven by reductions in total installed system costs for technologies.



1. Parabolic trough technology. For comparison purposes, low end is for 2008, since 2003 costs exclude thermal storage.
2. Low end is without thermal storage, high end is with 12 hours thermal storage.
3. Some small hydro is dispatchible, some is not.
4. Thermal storage provide some dispatchibility and control of output.
5. These are effective capacity factors, including effects of temperature degradation and dust losses.

Government programs are among the many drivers creating a sustained market demand for renewable energy.

	Factors Affecting Demand for Renewable Energy					
	Climate Change[1]	Environ-mental Issues	Energy Security	Consumer Demand	Increased Reliability	Local Economic Development
Europe	●	●	●	◑	○	◑
Japan	◑	●	●	◑	○	○
United States	◑	◑	●	◑	◑[2]	◑
Developing Countries	○	○	◑	●	◑	●

1. Government vs. individuals
2. Region specific

● High ◑ Medium ○ Low

Global policies are supporting renewable energy development.

United States

- Production tax credits (1.8¢/kWh) for wind and closed-loop biomass
- Renewable portfolio standards (RPS) in 12 states; renewable energy funds in 15 states
- Alternative fuels incentives in several states
- Green pricing programs
- 36 states with net metering programs
- Interconnection standards

Europe

- EU directive to source 12.5% renewable energy by 2010
- 100,000 rooftop program for photovoltaics (PV) in Germany (till the end of 2003)
- Guaranteed buy-back prices and preferential feed-in laws (as high as ~$.45/kWh for PV in Germany)
- Eleven countries are taking part in the test phase on the Renewable Energy Certificate System (RECS)
- Green pricing programs resulting in 1.4 million green energy customers
- EU reduction goal of 15% for greenhouse gas emissions by 2010
- UK's Export Credits Guarantee Department (ECGD) is providing ~$70 million annually to the renewable energy industry to foster growth

China

- Renewable energy included in the Five-Year Plan
- Low-interest loans available
- China Renewable Energy Scale-Up Programme aims to increase RE electricity by 14.3 GW by 2010
- Subsidies for solar and wind in remote areas

India

- Commitment to source 10% renewable energy by 2012
- Extremely good loans and depreciation

Australia

- Target of 2% electricity generation from renewables by 2010
- Implemented formal green trading scheme

Japan

- Subsidies for PV manufacturing and low interest loans
- Subsidize up to $.80/Wp for PV
- RPS began in April 1, 2003: 3.28 TWh of renewable energy through 2004 and increasing to 12.2 TWh (1.35% of total power) by 2010
- Formal green trading program started in 2001

Note: Examples given are not exhaustive within countries or regions and many other countries are not listed

In addition to government drivers, there are many other common drivers and barriers that continue to shape the renewable energy market.

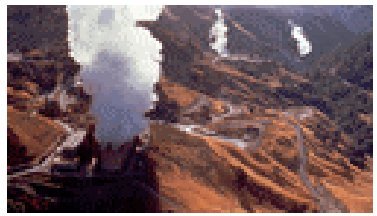
Renewable Energy Market Drivers
• Improving economics such that some options are now competitive or nearly competitive with conventional options • Energy security and diversity • Economic development • Emissions benefits (air quality and climate change) • Consumer support for environmentally friendly technologies • Energy price volatility • Government support – Renewable Portfolio Standards – Feed-in tariffs – Renewable Energy Funds – Production tax credits and other similar incentives – Net metering

In addition to government drivers, there are many other common drivers and barriers that continue to shape the renewable energy market (continued).

Renewable Energy Market Barriers
• High first costs relative to competing technologies • Lack of guaranteed long-term government commitment to providing incentives • Lack of appropriate incentives that reflect the different stages of development of the various technologies • Grid integration issues – For some, the dispersed and/or remote nature of the resources is a mismatch with the current T&D infrastructure. – For others, the small-scale of application makes interconnection and permitting costly – For some - dispatchibility • Various concerns over aesthetics, noise and environmental impact depending on the technology • High uncertainty and instability in Renewable Energy Certificate markets

Large corporations are staking out strong positions to capitalize on growth opportunities and the U.S. needs to be well positioned to compete.

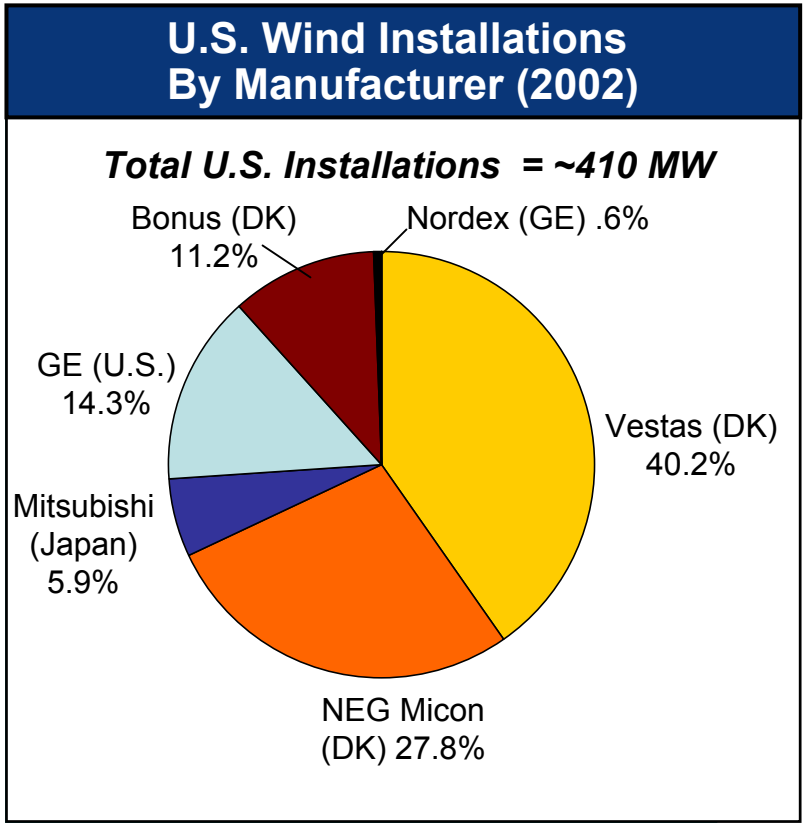
Examples of Large Corporate Players in Renewable Energy

Photovoltaics 	• Sharp • BP Solar • Kyocera • Shell Solar • Sanyo • RWE Schott Solar	**Low-Impact Hydropower** 	• GE Hydropower • ABB Alstom Power • VA Tech
Wind Power 	• Vestas • NEG Micon • Enercon • GE Wind • Mitsubishi • FPL Energy • National Wind Power • Shell Wind • ABB	**Concentrating Solar Power** 	• Solargenix Energy • Gamesa • Industrial Solar Technology • FPL Energy • Constellation • SMUD[3]
Biomass Power 	• Foster Wheeler • DTE Biomass • Caterpillar[1] • Waukesha[1] • Solar Turbines[1] • All pulp & paper co's[2]	**Geothermal** 	• Calpine • Caithness Energy • Ormat • Mitsubishi • Toshiba • Fuji

1. Suppliers of engines and gas turbines for landfill gas and biogas projects
2. Owners of most existing biomass power capacity in North America
3. Sacramento Municipal Utility District.

Many of the large renewable energy players are not U.S. companies. Foreign companies frequently do business or have manufacturing in the Unites States…

Global Supply of Wind Turbines (2002)			
Manufacturer	Sales (MW)		2002 Market Share (%)
	2002	Total	
Vestas (DK)	1,605	6,588	21
Enercon (GE)	1,334	4,540	18
NEG Micon (DK)	1,033	5,543	14
Gamesa (ES)	854	2,979	11
GE Wind (U.S.)	638	2,925	9
Bonus (DK)	509	2,815	7
Nordex (GE)	504	1,978	7
MADE (ES)	247	1,030	3
Repower (GE)	223	602	3
Ecotecnia (ES)	120	482	2
Other	371	4,048	5
Total	7,438	33,530	100



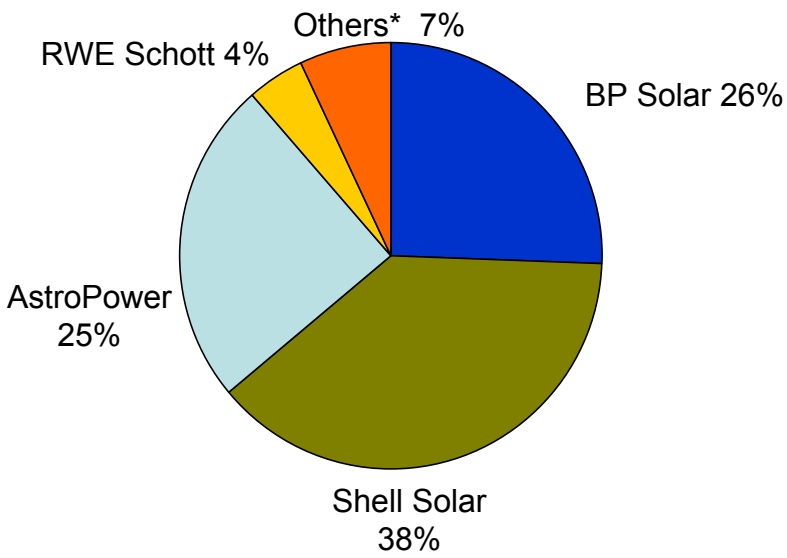
Source: NCI data based on BTM Consults, 2003; AWEA; and wind manufacturer interviews, May 2003.

U.S. Company

Many of the large renewable energy players are not U.S. companies. Foreign companies frequently do business or have manufacturing in the Unites States (continued).

Global Supply of PV Modules/Cells (2002)		
Manufacturer (Company Headquarters)	**2002 Production (MW)**	**2002 % Share of World Production**
Sharp (Japan)	123.1	22
BP Solar (UK)	71.4	13
Kyocera (Japan)	60.0	11
Shell Solar (UK)	55.5	10
Sanyo (Japan)	30.0	5
AstroPower (U.S.)	29.7	5
RWE Schott Solar (GE)	29.5	5
Isofoton (ES)	27.4	5
Mitsubishi (Japan)	24.0	4
Photowatt (France)	17.0	3
Others*	92	15
Total	**559.6**	**100**

PV Cell Production in the U.S. By Manufacturer (2002)



*Includes United Solar, Evergreen Solar, First Solar, Global Power, Sun Power, Amonix. AstroPower, United Solar, Evergreen Solar, and Amonix are U.S. owned.

Source: NCI estimates based on Photon International, PV Energy Systems and manufacturer interviews, 2003.

U.S. Company

In concluding, there is tremendous growth that is expected for renewable energy over the next 10 years. The U.S. needs to position itself to capture its share of this business opportunity.

Technology

- Technology performance (efficiency and reliability) continues to improve.
- Many renewable energy technologies have experienced significant cost reductions and are approaching competitiveness with conventional power
  - Wind and PV are 1/10th the cost they were in the early 1980s and additional cost reductions of ~5% per year (real terms) are expected in the near-term

Markets

- Wind and PV markets have seen 15 – 25% annual growth over the past five years.
- Globally, installed renewable energy capacity is expected to more than double over the next ten years from ~130 GW in 2003 to 300 GW in 2013.
- About 75% of the renewable energy market opportunity with be outside of North America
- Governments throughout the world are supporting renewable energy development due to climate change, energy security, consumer demand, added reliability, and economic development

Opportunities for U.S. Companies

- Renewable energy markets are growing faster than conventional power technologies at 9.2% CAGR vs. 2.4% CAGR for the electric power sector
- U.S. companies currently do not have a major market share of this business opportunity and if they do not position themselves well over the next few years could loose market share of the expected $35 billion business potential in 2013